Appendix

Derivation of $V_{BE}(T)$ by importing the constant $V_{BE}(T_r)$. This derivation is referenced in chapter 3 on page 40.

\[ V_{BE} = V_{g0} + \frac{kT}{q} \ln \frac{I_C}{CT^n} \quad (2-1) \]

\[ V_{BE} = V_{g0} + \frac{kT}{q} \ln \frac{I_C T^n}{CT^n T^n} \quad (2-2) \]

\[ V_{BE} = V_{g0} + \frac{kT}{q} \left( \ln \frac{I_C}{CT^n} + \ln \frac{T^n}{T^n} \right) \quad (2-3) \]

\[ V_{BE} = V_{g0} + \frac{kT}{q} \left( \ln \frac{I_C}{CT^n} + \eta \ln \frac{T^n}{T} \right) \quad (2-4) \]

\[ V_{BE} = V_{g0} + \frac{kT}{q} \ln \frac{I_C}{CT^n} + \frac{kT}{q} \eta \ln \frac{T^n}{T} \quad (2-5) \]

\[ V_{BE} = V_{g0} + \frac{T}{T_r} \left( \frac{kT}{q} \ln \frac{I_C}{CT^n} \right) + \frac{kT}{q} \eta \ln \frac{T^n}{T} \quad (2-6) \]

\[ V_{BE} = V_{g0} - \frac{T}{T_r} V_{g0} + \frac{T}{T_r} \left( V_{g0} + \frac{kT}{q} \ln \frac{I_C}{CT^n} \right) + \frac{kT}{q} \eta \ln \frac{T^n}{T} \quad (2-7) \]

\[ V_{BE} = V_{g0} \left( 1 - \frac{T}{T_r} \right) + \frac{T}{T_r} V_{BE}(T_r) + \frac{kT}{q} \eta \ln \frac{T^n}{T} \quad (2-8) \]
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